CLAIMS

What is claimed is:

1. A single-chip structure of silicon germanium photodetectors and high-speed transistors which comprise of:

a substrate;

a phototransistor, which is formed on a side of the substrate;

a high-speed bipolar transistor which is relocated in the opposite side of the phototransistor on substrate; and

a separated insulation-layer, using this layer to separate the phototransistor and the high-speed bipolar transistor, consisting of the above components, a single-chip structure of the phototransistor and the high-speed bipolar transistor can be completely implemented on a same substrate.

2. A single-chip structure of SiGe photodetectors and high-speed transistors, which comprises of claim 1 wherein the substrate can be making from a silicon wafer or a silicon-on-insulator wafer.

3. A single-chip structure of SiGe photodetectors and high-speed transistors, which comprises of claim 1 wherein the phototransistor and high-speed bipolar transistor structure includes:

a composite collector layer consists of a collector layer and a photo-absorbing layer, wherein the photo absorbing layer is formed on the collector layer;

a base layer, located on the composite collector layer;

an emitter layer, formed on the base layer.

4. A single-chip structure of SiGe photodetectors and high-speed transistors, which comprise of claim 1 wherein the separated insulation layer is either made by filling the deep trench with the insulation material or using the reverse p-n junction, it can isolate the photo-detecting zone and the high-speed transistor zone distinctly.
5. The structure of the phototransistor and high-speed bipolar transistor, which comprise of claim 3 wherein the collector layer of the composite collector layer, can choose silicon to make it.
6. The structure of the phototransistor and high-speed bipolar transistor, which comprise of claim 3 wherein the photo-absorbing layer can adopt either $Si/Si_{1-x}Ge_x$ multiple quantum well or superlattice, the X range of Ge component in $Si_{1-x}Ge_x$ is defined as $0<X\leqq 1$, not only owns the ability to absorb the light spectrum with an infrared wavelength, also improves the light absorption efficiency indeed.
7. The structure of the phototransistor and high-speed bipolar transistor, which comprise of claim 3 wherein the base layer can made of either silicon or silicon germanium, then its thickness is determined by the required speed performance of the high-speed bipolar transistor.
8. The structure of the phototransistor and high-speed bipolar transistor, which comprise of claim 3 wherein the emitter layer can be made of silicon, poly silicon or silicon germanium, its thickness can be as smaller as 10 nm and goes up to unbounded.

9. The structure of the phototransistor and high-speed bipolar transistor, which comprise of claim 3 wherein the emitter and collector layers shall be n-type doping, if the base layer is the p-type doping, the emitter and collector layers shall be p-type doping with n-type doping to the base layer, the photo-absorbing layer of the phototransistor can be made of an intrinsic (no doping), n-type, or p-type material.

10. The structure of the phototransistor and high-speed bipolar transistor, which comprise of claim 3 wherein the emitter layer can be designed to partially or totally cover the base layer.

11. A single-chip structure of SiGe photodetectors and high-speed transistors, which comprise of:

a substrate;

a photodiode, which is formed on a side of the substrate;

a high-speed bipolar transistor which is relocated in the opposite side of the photodiode on substrate; and

a separated insulation layer, using this layer to separate the photodiode and the high-speed bipolar transistor, consisting of the above components, the photodiode and the high-speed bipolar transistor can be completely implemented by using a single-chip structure.

12. A single-chip structure of SiGe photodetectors and high-speed transistors, which comprises of claim 11 wherein the substrate can be choosing from silicon wafer or silicon-on-insulator wafer.

13. A single-chip structure of SiGe photodetectors and high-speed

transistors, which comprises of claim 11 wherein the photodiode and high-speed bipolar transistor structure includes:

a composite collector layer consists of a collector layer and a photo-absorbing layer, wherein the photo-absorbing layer is formed on the collector layer;

a base layer, formed on the composite collector layer;

an emitter layer, formed on the base layer of the high-speed bipolar transistor, but the photodiode has no emitter layer.

14. A single-chip structure of SiGe photodetectors and high-speed transistors, which comprises of claim 11 wherein the separated insulation layer is either made by filling the deep trench with the insulation material or using the reverse p-n junction, it can isolate the photo-detecting zone and the high-speed transistor zone distinctly.

15. The structure of the photodiode and high-speed bipolar transistor, which comprises of claim 13 wherein the collector layer of the composite collector layer, can choose silicon to make it.

16. The structure of the photodiode and high-speed bipolar transistor, which comprises of claim 13 wherein the photo-absorbing layer can adopt either $Si/Si_{1-x}Ge_x$ multiple quantum well or superlattice, the X range of Ge component of $Si_{1-x}Ge_x$ is defined as $0<X\leqq 1$, not only owns the ability to absorb the light spectrum with an infrared wavelength, also improves the light absorption efficiency indeed.

17. The structure of the photodiode and high-speed bipolar transistor,

which comprises of claim 13 wherein the base layer can made of either silicon or silicon-germanium, then its thickness is determined by the required speed performance of the high-speed bipolar transistor.

18. The structure of the photodiode and high-speed bipolar transistor, which comprises of claim 13 wherein the emitter layer of the high-speed bipolar transistor can be made of silicon, poly silicon or silicon-germanium, its thickness can be as smaller as 10 nm and goes up to unbounded.

19. The structure of the photodiode and high-speed bipolar transistor, which comprises of claim 13 wherein the emitter and collector layers shall be n-type doping, if the base layer is the p-type doping, oppositely the emitter and collector layers shall be p-type doping with n-type doping to the base layer, the photo-absorbing layer of the phototransistor can be made of an intrinsic (no doping), n-type, or p-type material.